

## Assessing Potential Health Impacts of Wind Turbine Noise: A Longitudinal Look at Multiple End Points

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<https://doi.org/10.1289/EHP5374>

The issue of wind turbine noise has raised concern in communities around the planet, from the Australian bush<sup>1</sup> to Cape Cod, Massachusetts.<sup>2</sup> Over the past decade, claims that wind turbine noise is harmful have proliferated in response to new and proposed wind energy projects, leading in some cases to significant public opposition, withdrawn projects,<sup>3</sup> and even decommissioned turbines.<sup>4</sup> Two reports in *Environmental Health Perspectives (EHP)*<sup>5,6</sup> examine separate end points related to exposures to wind turbine noise.

In the first paper,<sup>5</sup> people over age 65 exposed to high levels of wind turbine noise at home appeared more likely to fill prescriptions for sleep medication. To a lesser degree, these individuals also appeared more likely to fill prescriptions for antidepressants.

The second *EHP* article assessed the risk of stroke and heart attack.<sup>6</sup> The authors estimated a slight increase in risk of heart attack among those exposed to the highest noise levels, compared with the least-exposed group. Their results did not support an association with stroke.

Four earlier papers produced by the same Danish government-funded research group, published throughout 2018, investigated

associations between wind turbine noise and hypertension,<sup>7</sup> cardiovascular events (in relation to short-term exposure),<sup>8</sup> diabetes,<sup>9</sup> and birth outcomes.<sup>10</sup> None of those papers supported associations with wind turbine noise.

To conduct their analyses, the researchers used national registries containing decades of residence and health data for hundreds of thousands of residents of Denmark. They also drew from federal data on more than 7,000 wind turbines in the country.

The researchers stress that their results should not be interpreted as full exoneration of wind turbine noise. One reason is that the study population shrank substantially when limited to those whose homes were near enough to wind turbines to experience high levels of noise. This limit reduces statistical power and thus reliability when drawing conclusions about health outcomes associated with exposure to the loudest wind turbine noise, says lead author Aslak Harbo Poulsen, an epidemiologist with the Danish Cancer Society Research Center.

“The cohort is quite huge, but only a very small proportion of these people have exposure levels that we would expect to potentially have an effect. We didn’t really know when we started out



Several studies of noise-related health effects, including wind turbine noise, have pointed to annoyance as a potential pathway to physiological symptoms.<sup>11</sup> However, annoyance is a difficult pathway to pin down—it is highly subjective and hard to quantify. Image: © Pixabay.

how many Danes were exposed to high levels of wind turbine noise,” Poulsen says. “And then of course when you only have a few high-exposed people, there is great uncertainty about the results.”

As it stands, the research—and particularly what is presented in the new *EHP* papers—does seem to indicate that any potential health effects would be more likely at the highest (and rarest) exposure levels, Poulsen notes. For these studies, that exposure is defined as exceeding 42 decibels outdoors or 15 decibels indoors—about as loud as ventilation noise in an office or the rustling of leaves, respectively.

However, says Poulsen, all noise is not equal in terms of how annoying it may be. “It is not necessarily the mean noise level, per se, that [potentially causes any health effects],” he says. “It could be other aspects of noise associated with the mean noise level.”

Prior to the new Danish study, much of the health effects research on wind turbine noise has been less than reliable and far from consistent, says Alice Freiberg of Germany’s Dresden University of Technology. She was lead author of a 2019 scoping review of the health effects of wind turbines in residential settings.<sup>11</sup>

According to criteria established for Freiberg’s review, the new *EHP* paper on associations between wind turbine noise and strokes/heart attacks<sup>6</sup> represents the first “high-quality” study of its kind. In addition to being prospective in design, “There was no selection bias, no information bias for the exposure and outcomes, and at least age, sex, and socioeconomic status were regarded as confounders,” Freiberg says. The *EHP* paper draws on a study population of approximately 712,000 adults, plus information on diagnoses from national hospital and mortality registries dating back to 1982.

As far as sleep disorders and mental health go, Freiberg’s review identified only one previous “high-quality” study looking at comparable outcomes with respect to wind turbine noise. That study, completed by Health Canada in 2016,<sup>12</sup> relied on questionnaires and data recorded via wrist-worn sensors to assess sleep quality among 1,200 residents of two Canadian provinces. In contrast to the *EHP* study on the same subject<sup>5</sup>—which drew on data from approximately 584,000 citizens and prescription records spanning 18 years—the results of the Canadian study did not support an association with self-reported problems sleeping.

The Danish program represents a turning point for the field, Freiberg says. These new studies have moved away from cross-sectional study designs investigating the influence of outdoor noise levels on subjectively measured outcome variables, she explains. The new longitudinal research considers low-frequency indoor noise levels and assesses health impacts with objective, clinically relevant data.

Igho Onakpoya, a research fellow at the University of Oxford who was lead author of a 2015 review and meta-analysis of the effect of wind turbine noise on sleep and quality of life,<sup>13</sup> says the Danish study stands out for its large population and long follow-up times. “I am not sure I’ve seen such a large sample size in a wind turbine study,” he says.

To gain further insight into potential effects on sleep, as well as implications for other aspects of physical and mental health, future research could use controlled laboratory experiments to

measure physiological responses to various types of wind turbine noise, Poulsen says. Such studies are already under way<sup>14,15</sup>—though any results that may help put the debate to bed remain a few years off.

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